



Case report

Combined olecranon osteotomy with triceps reflecting approach for complex humerus fractures

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1. Introduction

Combined humeral shaft and distal intra-articular fracture patterns present a unique surgical challenge. Various surgical approaches have been described for both the humeral shaft^{5,15,18,19,24,25} and the distal humerus individually^{1,4,7,13–17,21–23,25,27,29,33–35,37} but few exposures allow combined intra-articular and humeral shaft exposure simultaneously.^{2,10,20,26} The combined olecranon osteotomy and posterior triceps-splitting approach as originally described by Ebraheim et al.¹⁰ has recently been reviewed by Archdeacon.² We report a combined anconeus sparing olecranon osteotomy with proximal triceps reflection or Gerwin approach for simultaneous access to both the distal and diaphyseal humerus.

2. Case series

Two cases have required this combined approach at our level-one trauma centre in the past year. Case 1 is a 44 year-old right hand dominant male who presented after a mechanical fall with right elbow pain with a normal neurologic exam. Radiographs showed a combined humeral shaft fracture with an intra-articular distal humerus fracture, OTA 13-C3.3 (Fig. 5). The combined technique was utilized because of need for simultaneous humeral shaft and intra-articular visualization.

In this approach, the patient was placed in the lateral decubitus position with the operative arm supported with a bolster in a position allowing full extension and at least 90° of flexion. The entire upper extremity was prepped circumferentially. A midline posterior incision was made between the lateral and medial

brachial cutaneous nerves extending approximately 5 cm distal to the olecranon tip.

The triceps fascia was split longitudinally and the anconeus muscle was isolated by identifying the fascial stripe radial to the muscle belly (Fig. 1). An anconeus sparing approach was performed as described by Athwal et al.³ The ulnar nerve was identified proximally as it exited the intermuscular septum, exposed along its course and transposed subcutaneously marking it with a vessel loop.

A distal chevron osteotomy was made initially with an oscillating saw and completed with an osteotome. The anconeus-triceps pedicle was reflected proximally lifting it from lateral to medial off the triceps fascia which we follow to where it inserts into the lateral humerus as the lateral intermuscular septum. Great care should be taken to avoid inadvertently penetrating this fascia which can lead to a bloody, challenging dissection. The radial nerve and profunda brachii artery were identified by tracing branches of the radial nerve proximally to the main nerve trunk. Additionally, the lateral intermuscular septum can be released to allow improve retraction of the nerve if necessary. Access to the proximal humerus was obtained by bluntly developing the plane between the deltoid and triceps muscle fibres. The under surface of the deltoid fascia is easily identified and can be followed to its insertion onto the humerus. The triceps muscle fibres are elevated from this fascia and then the proximal humerus working in a lateral to medial direction. The use of Hohmann retractors placed medially on the humerus aids in this dissection and allows better visualization (Fig. 2). The proximal dissection reflects the triceps muscle en masse whilst leaving the deltoid undisturbed thus creating a proximal and a distal window for humeral shaft exposure on either side of the neurovascular bundle (Fig. 2). Dissection proximally is limited by the crossing axillary nerve (Fig. 3). This approach maximizes both intra-articular visualization and humeral shaft exposure simultaneously (Fig. 4).

Articular reconstruction was accomplished using standard techniques^{6,8,11,32} and pre-contoured distal humerus locking plates (Synthes, Paoli, PA). After hemostasis is obtained and irrigation performed, closure is performed in routine fashion according to surgeon preference. The triceps fascia is frequently found to be too tight to close and is left open in those cases. The anconeus is repaired to its bed with an absorbable suture. The skin

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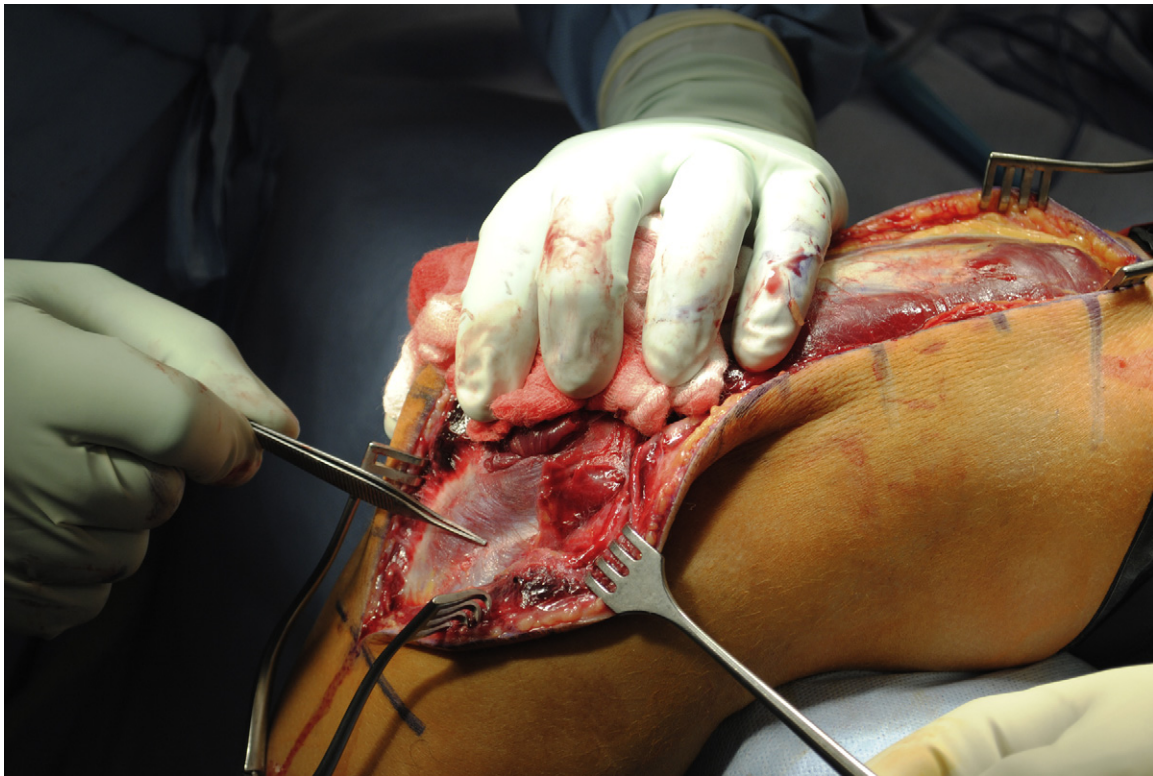


Fig. 1. Intra-operative photograph illustrating the fascial stripe of the anconeus muscle just radial to the muscle belly.

is then closed with a manner determined by surgeon preference. Drains are used on a selected basis. Postoperatively the arm is immobilized in a long arm splint and elevated to an IV pole for two days at which time aggressive physical therapy is started.

At one year follow-up the patient's fracture was healed ([Fig. 6](#)) and he had 30–110° of elbow range of motion with aggressive physical and occupational therapy and use of a turnbuckle type orthosis. He is gainfully employed, pleased with his result and has

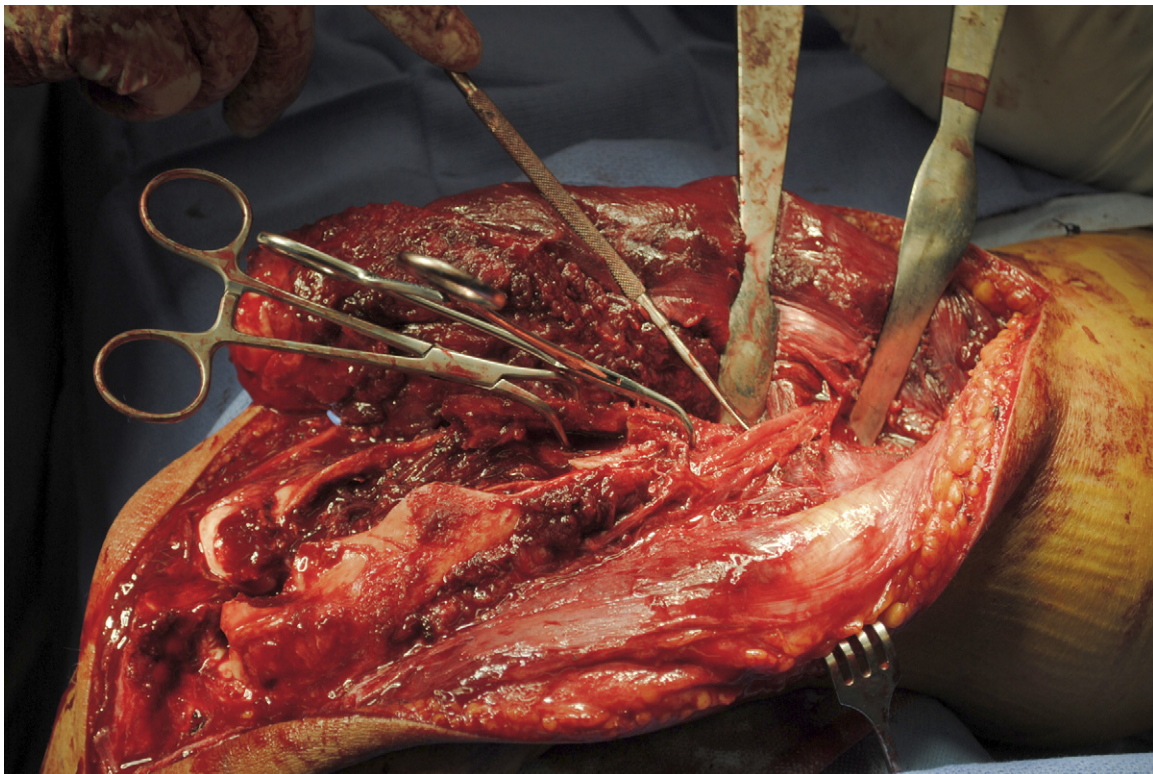


Fig. 2. Intra-operative photograph illustrating the triceps reflection with both proximal and a distal windows utilized for visualization of the humeral shaft. Hohmann retractors are seen around humeral shaft just proximal and distal to neurovascular bundle depicted by septal elevator.



Fig. 3. Cadaveric specimen illustrating the final intra-articular and humeral shaft exposure achieved. Axillary nerve marked by arrow.

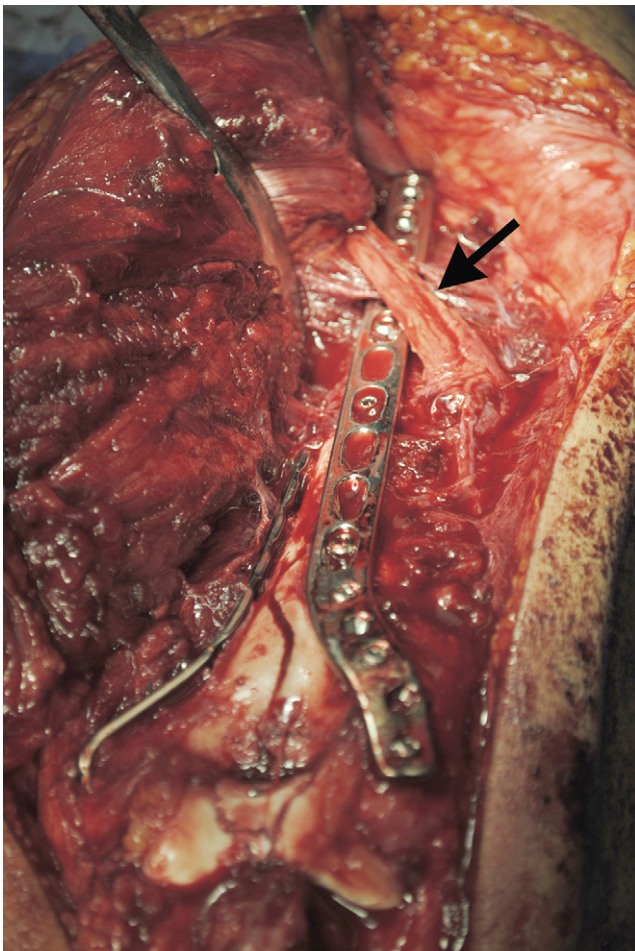


Fig. 4. Intra-operative photograph illustrating the visualization for humeral shaft and intra-articular exposure. Radial neurovascular bundle marked by arrow.

declined surgical intervention to address his restricted range of motion.

The second case is a 73 year-old right hand dominant female who presented after a mechanical fall with left elbow pain, lack of wrist and finger extension, and numbness of the first dorsal web space. She previously underwent a long-stem proximal humerus hemiarthroplasty several years ago for an unknown reason. Radiographs showed a combined periprosthetic humeral shaft fracture with an intra-articular distal humerus fracture, OTA 13-C3.3 (Fig. 7). The combined technique was utilized because of need for maximum intra-articular visualization and the need for shaft access to cerclage around the stem of the humeral component (Fig. 8). She initially did well post-operatively but became unresponsive in respiratory failure just before discharge on post operative day #2. CT scan was negative for pulmonary embolus but positive for bilateral pneumonia. After a prolonged hospital course, the family withdrew care and the patient ultimately expired.

3. Discussion

In our small case series, simultaneous access to both the humeral shaft and joint was required based on somewhat unique fracture patterns. This approach compares to that initially described by Ebraheim et al.¹⁰ and reviewed by Archdeacon² but utilizes what we feel is amore muscle sparing approach by reflecting the triceps muscle belly rather than splitting it.

The olecranon osteotomy provides the maximal exposure to the intra-articular distal humerus.³⁶ The main potential drawbacks to the olecranon osteotomy are nonunion and symptomatic hardware. Ring et al. described a distal chevron-shaped olecranon osteotomy technique resulting in a 98% osteotomy union rate.³¹ Similarly, Coles et al. reported the use of a chevron-shaped osteotomy with placement of either intermedullary screws or dorsal ulnar wiring resulting in zero osteotomy nonunions in 67 patients.⁹ The incidence of symptomatic implant requiring removal ranges from 8 to 13%.^{9,31}



Fig. 5. Pre-operative antero-posterior and lateral radiographs illustrating comminuted humeral shaft fracture with intra-articular extension (OTA 13-C3.3).

The triceps-sparing and splitting approaches to the distal humerus offer the advantage of preserving the attachment of the triceps tendon to the olecranon³⁰ whilst eliminating the risk of nonunion and symptomatic hardware related to olecranon osteotomy. Their major drawbacks, as compared to the olecranon osteotomy, are less visualization of the distal humeral articular surface,³⁶ limited humeral shaft exposure,¹² triceps muscle weakness and increased blood loss.³⁰ Pajarinen and Bjorkenheim showed that patients undergoing an olecranon osteotomy had better functional outcomes than those undergoing an isolated triceps-splitting approach.²⁸

The combination of an olecranon osteotomy with a proximal triceps reflection is a novel addition to humeral surgical approaches. The olecranon osteotomy provides maximal intra-articular exposure.³⁶ The proximal triceps reflection approach of

Gerwin allows for the most extensile visualization of the humeral shaft whilst permitting identification and protection of the radial nerve and profunda brachii artery.²⁷ The triceps reflecting technique eliminates intramuscular dissection and avoids the associated morbidity implying less postoperative pain, triceps dysfunction, and blood loss. As compared to other described combined approaches, proximal humeral shaft dissection utilizes natural fascial planes thus avoiding deltoid insertion elevation or splitting of the triceps muscle.²⁰ The senior author routinely utilizes an olecranon osteotomy for intra-articular fracture fixation and a triceps reflecting approach for fixation of humeral shaft fractures and non-unions individually. This novel technique combines these individual approaches for simultaneous extensile exposure of the distal and diaphyseal humerus.

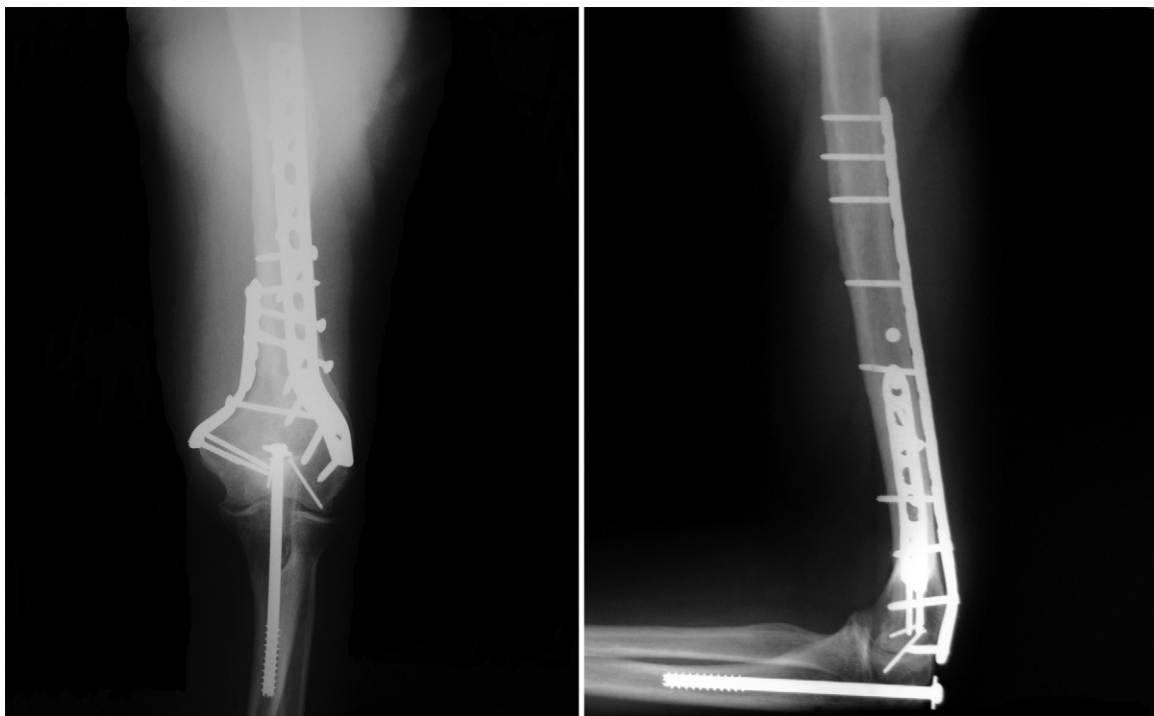


Fig. 6. Post-operative antero-posterior and lateral radiographs following fracture fixation at 6 month follow up.

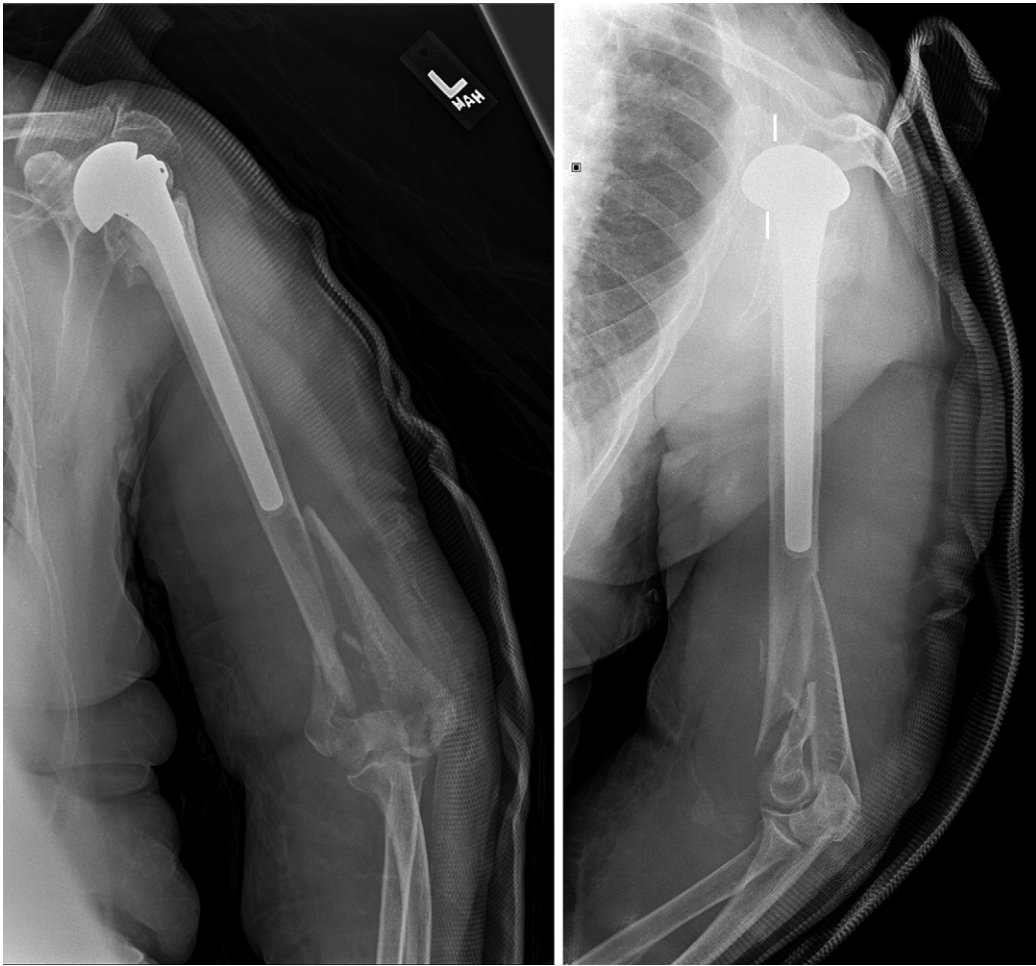


Fig. 7. Pre-operative antero-posterior and lateral radiographs illustrating comminuted periprosthetic humeral shaft fracture with intra-articular extension (OTA 13-C3.3).



Fig. 8. Post-operative antero-posterior and lateral radiographs following fracture fixation.

4. Conclusion

This case report demonstrates a combined olecranon osteotomy with proximal triceps reflection as an addition to the surgical armamentarium for obtaining simultaneous extensile humeral shaft and intra-articular exposure when required. The technique is ideal for cases where the fracture pattern is complex and maximum visualization is needed.

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